REMARKS

Claims 11 to 24 are pending in the application; claims 13-15 and 18-24 are withdrawn.

Claim Rejections - 35 U.S.C. 112

Claims 11-12 and 16-17 stand rejected under 35 U.S.C. 112, 2nd paragraph, as being indefinite. The examiner points out that it is unclear what "starting material" refers to in the body of the claim.

Claim 11 has been amended to specify that the roll forming process is carried out on tubular starting material (i.e., a pipe); similar changes have been carried out in claim 18.

Reconsideration and withdrawal of the rejection of the claims under 35 USC 112 are respectfully requested.

Rejection under 35 U.S.C. 103

Claims 11-12 and 17 stand rejected under 35 U.S.C. 103(a) as being unpatentable over *DE 195 26 900* in view of *Connell (US 3,992,914)*.

Examiner argues that DE 195 26 900 discloses combining machine-cutting processes with one another sequentially, parallel, or sequentially / parallel wherein only a roll forming process is missing and the step of generating during the roll forming process an axial counterforce relative to the flow direction of the starting material by an axially arranged counterpressure tool such that material flow in at least one of axial direction and radial direction is controlled such that flowing material is integrated into the profile of the ring.

The Examiner refers to *Connell* as disclosing a roll forming process and generating during roll forming the axial counterforce in the manner claimed in claim 11. In Examiner's view, therefore it would have been obvious to combine the roll forming process as disclosed in *Connell* with the combined machine cutting processes of DE 195 26 900.

Examiner has not specified in the last office action where in *Connell* he finds support for his statement that the reference discloses an axial counterforce applied in the manner claimed in instant claim 11. Applicant respectfully requests that Examiner specify where such disclosure can be found.

Applicant respectfully submits that there is no evidence or support that an axial

counterforce is applied in the method of *Connell*.

The apparatus of *Connell*, as disclosed in Fig. 1, shows two roll forming rolls 2, 4 between which the workpiece 6 is positioned on arbor 8. Also shown in Fig. 1 are two growth control rolls 22, 24, displaced by 90 degrees in circumferential direction relative to the rolls 2, 4; these rolls 22, 24 are designed to reduce any ovality in the workpiece 6 produced by the rolls 2, 4 during rolling (col. 2, lines 34 to 39, of *Connell*). The general function of the rolls 22, 24 is disclosed in detail in column 1, lines 35-64, of *Connell*:

> "The blank is located on a mandrel, which is preferably a split mandrel (described in copending Ser. No. 597,740 filed July 21, 1975 and the growth control rolls made to rest on the blank. At this point in the rolling cycle the force exerted by the growth control rolls is approximately 200 to 500 lbf. This force is maintained during rolling until the forming rolls have reached a preset position at which point the ring being rolled starts to increase rapidly in diameter.
>
> The force exerted by the growth control rolls is then increased substantially to a preset figure to contain this diametral growth, and these rolls continue to move towards one another until the adjustable dead stop is reached.
>
> The pressure change over point is always a constant distance from the full depth final roll position, for a given size and type of ring. The force varies with the type and size of ring rolled. The change in force is smoothly applied, using for example a hydraulic accumulator because if this higher force is applied too suddenly the traction applied by the forming rolls is lost, resulting in severe metal pick-up on these rolls. If applied too late, the ring will have increased substantially in diameter preventing accurate size control and increasing the possibility of fatigue and fracture."

The growth control rolls 22, 24 act thus RADIALLY just like the rolls 2, 4. They act radially to control the diameter of the ring as it is being formed in the roll forming process.

Connell shows "counterpressure tools" only in the form of the rolls 22, 24 that are

used for controlling the diameter, but shows no AXIALLY arranged counterpressure tool that applies an AXIAL counterforce relative to the flow direction.

In the axial direction the workpiece is not subjected to any counterpressure as is evidenced by the apparatus of U.S. 3,803,890; note that *Connell* makes reference to the apparatus disclosed in U.S. 3,803,890 in col. 1, lines 3-5 and lines 28-29; col. 2, lines 37-39; as well as col. 4, lines 22-23, i.e., the method disclosed in *Connell* is performed on or designed for use in connection with the apparatus of U.S. 3,803,890. U.S. 3,803,890 is submitted herewith, accompanied by an information disclosure statement, as support for the arguments made in this amendment. U.S. 3,803,890 discloses details of the forming tools which are not apparent from *Connell* as *Connell* deals with control of the pressure being applied during roll forming by the hydraulic circuit.

The growth control rolls 22, 24 are supported in the same way as disclosed in U.S. patent 3,803,890 (col. 2, lines 38-40, of *Connell*). Note that the apparatus of Fig. 1 of *Connell* and of Fig. 2 of U.S. 3,803,890 are identical as regards the arrangement of the rolls of the roll forming part. The two apparatus differ only in the way the forming rolls 2, 4 and growth control rolls 22, 24 of *Connell* and the rolls 14, 50 of U.S. 3,803,890 are loaded by the hydraulic circuit.

The apparatus of U.S. 3,803,890 shows in Fig. 4 the configuration of the roll forming tool 14 (corresponding to forming tools 2, 4 of *Connell*) with flanks 60, 70 that enable the material of the workpiece to flow laterally (i.e., in axial direction). Fig. 7 and Fig. 8 of U.S. 3,803,890 show the workpiece before and after roll forming. Clearly, the material was allowed to flow in axial direction as evidenced by the widths C, F, G, H given in Figs. 7 and 8. The description in col. 10, lines 36-47, of U.S. 3,803,890 discloses the dimensions in inches for the two Figs. 7 and 8. Therefore, it is clear that the width C of the starting material of Fig. 7 at 0.584 inches is substantially less than the width F of 0.648 inches at the widest portion of the processed workpiece; the smaller widths G and H are identical and at 0.6397 inches much wider than the initial width C of 0.584 inches.

From this is clear that the apparatus as disclosed in U.S. 3,803,890 which is the same as the one used in connection with the method disclosed in *Connell* does not prevent axial flow; no axial counterforce is provided in U.S. 3,803,890 or in *Connell*. Note also the disclosure in col. 9, lines 32ff, of U.S. 3,803,890 where it is stated that

"...the metal flows during rolling to fill the profile of the rolls, the metal reaches the corner 70 and then flows up the side flanks 60".

This is illustrated generally in Fig. 4 and shown by the arrow 101. It is also stated in col. 9, lines 54-59, of US 3,803,890 that

"the initial workpiece has a small inside and outside diameter and narrower width than the finished shaped workpiece. The volume of the workpiece remains constant, however.".

It is also set forth in column 9, line 67, to col 10, line 1, that

"... it is possible for the metal to flow easily in the direction of the arrows 101 so reducing strains in the formed workpiece.".

In Fig. 4, arrow 101 indicates flow in axial direction and radial direction.

Applicant respectfully would like to point out again that in forming technology the law of constant volume rules (also stated in US 3,803,890: "The volume of the workpiece remains constant, however."; col. 9, lines 58-59). This means that for axial ring roll forming, as carried out by *Connell* and US 3,803,890, the initial ring that is cut before the rolling procedure in a separate process from a pipe must have precisely the volume of the final ring to be rolled (e.g. transmission ring or bearing ring). Only when the precise volume is already present, is it possible to produce the ring by rolling with the required precision without requiring any further machining steps. When excess material is present, the rolled ring must be post-machined.

Even worse, when the volume of the initial ring is too small, the shaped ring will have an incomplete shape and therefore it is unusable (scrap - waste of material and processing time).

When the volume of the initial ring is too great the excess material, as can be seen in Fig. 4 of US 3,803,890, will flow axially into the free space at the flanks 60, 70 because no resistance exists here. The result is that the rolled ring is too wide and requires

therefore additional machining of the end faces in a further separate working step on a separate machine tool.

Note also that the roll forming method of U.S. 3,803,890 requires a lateral support in the form of annular collars 42 (see col. 7, lines 35ff):

> "The collars 42 are urged against the sides of the workpiece by means of bellville springs 44 compressed between the collars and annular washers 46 which in turn bear on annular ridges 48 formed on the mandrel. These collars 42 do not prevent widthwise spreading of the workpiece but do ensure that the workpiece is accurately initially centered in relation to the annular humps 30 on the rolls 14 before rolling starts and the workpiece is contacted by the rolls 14."

The collars 442 thus ensure centering and allow flow at both ends of the ring blank. Such an equipment is not needed in the present invention where accordingly a pipe is used for roll forming and not a cut-to size individual ring. The pipe according to the present invention is damped with one end and only at the opposite end material flow is possible; this is clearly shown in the drawings in the instant Figs. 6a and 6b, for example.

As has been explained in the last response dated 7/14/2010, even when during axial roll forming the rolling tools provide a closed roll groove geometry (rolling tools cover end faces), in case of too large a volume of the initial ring the excess material will flow axially causing the closed roll groove to initially not close completely. The closed roll groove has a gap through which the excess material can flow out. As a result of this, the rolled ring has at both end faces a burr that must be subsequently removed by machining. This scenario happens quite frequently because the law of constant volume (volume of the initial ring = volume of the final ring) requires an extremely high expenditure in regard to manufacturing the initial ring to precise specifications. When the rolling force is increased up to the point of complete closure of the closed roll groove, rolling tool damage may occur

because the excess material has no escape route.

The above described disadvantages of axial ring rolling are alleviated by the present invention with the proposed axial pipe rolling method: controlling the material flow by axial counterforce applied by means of an axially arranged counterpressure tool (including the rolling arbor). In this way the law of constant volume is always complied with. The situation that too little volume is available for a ring to be rolled is impossible because the starting material is a pipe, i.e., the starting material is endless (continuous). In case of excess volume relative to the final ring to be produced, this excess material is removed by finish-machining in a processing step on the same machine and in this way the required precision of the final ring is achieved.

In summarizing the above, the reference to *Connell* shows only a counterforce being applied in the RADIAL direction by the rolls 22, 24 in order to ensure proper diameter. As evidenced by U.S. 3,803,890 (providing details of the apparatus of *Connell*), the material can flow freely in axial direction (compare before and after illustrations of Figs. 7 and 8).

Claim 11 is therefore not obvious in view of the combination of cited references.

Reconsideration and withdrawal of the rejection of the claims under 35 USC 103 are respectfully requested.

ALLOWABLE SUBJECT MATTER

Claim 16 is objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims. Applicant appreciates examiner's suggestion of allowable subject matter but is of the opinion that the claims as amended define over the prior art without requiring any limitation of the allowable claims.

CONCLUSION

In view of the foregoing, it is submitted that this application is now in

condition for allowance and such allowance is respectfully solicited.

Should the Examiner have any further objections or suggestions, the undersigned would appreciate a phone call or **e-mail** from the examiner to discuss appropriate amendments to place the application into condition for allowance.

Authorization is herewith given to charge any fees or any shortages in any fees required during prosecution of this application and not paid by other means to Patent and Trademark Office deposit account 50-1199.

Respectfully submitted on January 19, 2011,

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